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(54) Valve unit.

(57) The present invention mainly relates to a means and a method for the production of a movable part (1) and a housing (2) which accomodates the movable part, whereby the parts (1, 2) are moulded in one and the same tool and preferably the housing (2) is moulded in a first step and the disc (1) is moulded in a second step, and wherein said movable part (1) and housing (2) are produced in at least two steps in such a manner that the movable part (1) comprises a substantially sealing portion (11) which is intended to sealingly interact with a predetermined portion of said housing (2), whereby preferably said movable part is a butterfly disc (1) and said housing is a butterfly valve housing (2). The invention also relates to a specific product. Products which are produced according to the invention can be cheeper manufactured than habitual.

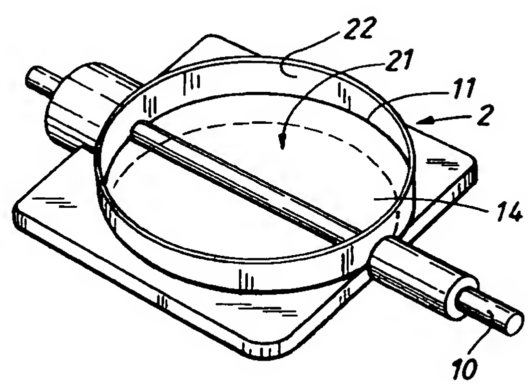

FIG. 1

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This invention relates to a device for controlling the volume of flow, comprising a flow controlling device which is pivotally arranged about an axis, (especially a butterfly plate) and a method and means for its production. A device of this kind can, for example, be used in order to control the flow of air into an otto engine.

A general problem with devices for controlling the volume of flow, having a flow controlling device, which is pivotally arranged about an axis within a channel, is that they are relatively expensive, since the production thereof is relatively complex. The production very often comprises several steps with different kinds of treatment, such as moulding, grinding, turning, assembly, control of sealing capacity, etc. It is common knowledge that each extra treatment implies an increase in the final price of the product, which is undesirable.

It is a first object of the invention to provide a device for control of the volume of flow, having a flow controlling device, which is pivotally arranged about an axis within a channel, wherein the number of treatment steps, necessary to obtain the final product is reduced to a minimum.

Said object is achieved by a product characterized in that the sealingly interacting surfaces of the channel and the flow controlling device have a configuration in a certain predetermined position which totally correspond since one of the surfaces is a casting of the other.

A further object of the invention is to provide a method and means for producing the above device in accordance with the invention, i.e. in accordance with that which is defined in claims 5 and 7.

Accordingly, it is a general goal within car industry to reduce the number of parts, since this leads to lower production and assembly costs. Another general goal, which has been developed more recently, is to try to optimize the included components to improve comfort and energy consumption. This latter goal has, for instance, resulted in designs which permit a "smooth" driving style. One result of such a design is that butterfly plates have been provided with flow decreasing means in order to optimize the relation between the effective through-flow area as a function of the rotation of the butterfly and thereby counter-acting the undesired, non-linear relation (in certain cases almost a sinus function) which leads to a jerky manner of driving at small opening angles. Known butterflies have such flow decreasing means in the form of separate parts which protrude transversely (so called rucksacks) which have been fitted to the base- surface of the butterfly. Accordingly, an optimization in accordance with the latter object has in this case led to a non-desired result concerning the number of parts.

It is a further object of the invention to provide a butterfly by means of which the above disadvantage is eliminated. Further, it is also an object of the invention to provide a butterfly valve unit comprising a housing and such a butterfly which consists of as few parts as possible.

In order to achieve the latter object, an optimal solution implies some kind of die-casting, of which thermal die-casting is preferred, but also other methods, such as curing, can be used. In the most preferred method, the production of the butterfly and the housing is performed in one and the same tool in two steps.

From US-A-4 702 156 it is known to use thermal moulding in order to produce a housing in a first step and movable parts for that housing in a second step in one and the same tool. This known method, however, relates to a through-flow channel with movable plates mounted therein for directing the air flow, which movable parts steer the air flow in a desired direction but do not control the volume of flow in accordance with the invention. Accordingly, there is an essential difference between the invention and this known device. Such a difference implies that a device in accordance with the invention has to have a movable part which, in a predetermined position, must sealingly interact with certain parts of the surrounding housing. It is obvious for the skilled man that the expression "sealingly" also relates to devices having a certain leakage flow. For otto engines, for example, it is preferred to have a total volume of flow leakage of about 4 m^3/h at idling, a flow which advantageously may be mainly supplied by means of leakage flow through a butterfly valve. The above-mentioned known device, however, does not include any kind of sealing interaction between the parts. This is a difference which implies major differences concerning production aspects. It is, accordingly, another object of the invention to provide a method for producing a movable device which forms a seal in a certain position and a housing which accomodates said movable device, whereby the movable part and the housing are preferably cast in one and the same tool in two distinct steps. Accordingly, it is a further object of the invention to provide a means for carrying out the method in accordance with the latter. It is also evident that the method is not limited to the production of butterfly valves, but that a butterfly valve in this respect is mentioned by way of example only.

Other advantages and objects of the invention will be apparent from the following claims and the following description.

The invention will be described in more detail in the following, with reference to the annexed drawings, in which,

Fig. 1

is a perspective view of a butterfly valving housing with a butterfly disc, showing a preferred embodiment of the invention,

Figures 2a and b

are two different side views of a butterfly disc according to the invention,

Figures 3a and b

show a preferred embodiment (perspective view and transversal section) of a butterfly disc according to the invention,

Fig. 4

shows a tool according to the invention in a first position,

Fig. 5

shows the same tool as in Fig. 4 in a second position,

Fig. 6

shows a section in the plane A in Fig. 5, and,

Fig. 7

shows a modified embodiment of a device according to the invention.

In Fig. 1 a perspective view of a valve housing 2 is shown within which a butterfly disc 1 is rotatably arranged. The butterfly disc 1 has a sealing outer edge 11, which, in the shown position, is intended to contact the inner surface 22 of the valve housing, which surface delimits a through channel 21. By means of the positioning of the butterfly disc 1, the flow through the channel 21 can be controlled. When the disc 1 is positioned transversally in relation to the channel, its sealing edge 11 will accordingly be in sealingly contact with the inner peripheral surface 22 of the channel 21, so that any through-flow is prevented. A rotation of the butterfly disc from this position implies, which is known per se, a successive opening of the channel 21. In Figures 2a and b there are shown two different side views of such a disc. The disc 1 consists of a disc-shaped part 14 and a shaft 10. The sealing edge 11 is the outer peripheral edge of the disc. The disc 1 is manufactured as an integral unit in a manner which will be explained in the following.

In Figures 3a and b there are shown a preferred embodiment of a butterfly disc in cross-section and a perspective view respectively. It is evident that the butterfly has a relatively complex configuration, which is due to the disc being designed with flow reducing means 12, 13 (so called rucksacks). The object of these flow reducing means are to optimize the effective through-flow of the channel 21 as a function of the rotational angle. In the preferred embodiment one of the rucksacks 12 protrudes about 15° from the plane which includes the sealing edge 11, whereas the second rucksack protrudes about twice that but in the opposite direction. For a conventional butterfly disc (Fig. 2) the through-flow of a channel is a non-linear function, which implies that in a certain position a smaller rotation of the shaft 10 leads to almost no change of the through-flow, whereas, in another position, the same small rotation leads to a large change of the through-flow. This is a phenomenon which is not always desired. This problem can be prevented by forming the butterfly disc with so-called rucksacks 12, 13 since these flow-reducing means are placed and designed in such a manner that the effective through-flow of the channel 21 varies linearly with respect to the rotational angle of the axis 10, a fact which, from a controlling aspect, is very often seen to be optimal.

In Figures 4 and 5 there are shown a tool for production of a butterfly disc and a housing in accordance with the invention. The production is performed in two steps whereby the housing is produced in the first step, having the different parts of the tool positioned in accordance with Fig. 4, and the butterfly disc 1 is produced in a second step, wherby the different parts of the tool are positioned in accordance with Fig. 5. In the preferred case, some kind of thermal plastic material is used, whereby the plastic material that is used in the first production step has a melting temperature that preferably exceeds the melting temperature of the plastic material which is introduced in the second production step, and which does not stick to this other one.

The following method in accordance with the invention will be clarified with reference to Figures 4 and 5. The tool for production of the device according to the invention comprises two outer mould parts 5, 6, which principally are movable parallel to a first plane A. Accordingly, these two outer mould parts have a dividing plane which is defined by the dividing surfaces 50, 60. This dividing plane is copositioned with a second plane B, which is a normal to the first mentioned plane A. A circular, through-passing hole coaxially with said dividing line 50, 60 is accordingly formed by two semi-circular recesses 53 and 63 respectively, in each part of the mould. Moreover, these mould parts 5, 6 have further recesses 52, 62 which are positioned adjacent to the through hole. These recesses 52, 62 define the delimiting surfaces which finally determine the outer contours of the housing.

Furthermore, each mould part 5, 7 has a through hole 53, 63 which has a diameter substantially smaller than that of the channel and which extends in said plane A, i.e. perpendicularly in relation to the channel and plane B. Both of these holes 53, 63 are coaxially arranged. Two cores 3, 4 (in the following, called "pins") are intended to be movable within said latter holes 53, 63. These pins have a constant circular cross-sectional surface and are accordingly intended to be moved in the plane A. The diameter of the two pins 3, 4 cor-

responds to the diameter of the holes 53, 63. Two other cores 7, 8 are intended to be moved along plane B within the channel, which is formed by the semi-circular surfaces 51, 61 of the outer mould parts 5, 6. Each core 7, 8 has a diameter which corresponds to the diameter of the channel where it is intended to be positioned. Each core has at its end-surface a diametrically, centrally extending groove 71, 81. Additionally, each core has recesses 73, 83 which are centrally positioned, in the middle of the dividing surfaces 70, 80, which recesses are transversally directed and circular and have a configuration which corresponds to the configuration of the ends 30, 40 of each respective pin. In the preferred case, accordingly, this is a circular recess having a diameter which corresponds to that of the end of each respective pin. This latter recess is (preferably) coaxially arranged in respect to said diametrically extending groove 81, 71. The radial extension of the groove 71, 81 is, at least at the borderline between the recess 73, 83 and the groove 71, 81, smaller in its radial extension than each respective recess 83, 73. As has already been mentioned, the production of the disc 1 and the housing 2 is made in two steps, whereby one and the same tool is used and the housing is moulded in a first step (Fig. 4) whereafter four parts 3, 4, 7, 8 of the tool are moved rearwardly to new positions (Fig. 5) so that the butterfly disc can be moulded in a second step. Thus, the newly moulded housing forms one of the outer delimiting surfaces when moulding the butterfly disc.

In Fig. 6 there is shown a cross-section in plane A in Fig. 5. This cross-section clearly shows the recesses 83 that are made in each core 8, in order to seal the inner cavity 81 by means of the pins 3, 4. This cavity 71, 81 forms a reinforcement of the disc 1. Further, the extension of the cavity which forms the disc, is represented. When using a tool 3, 4, 5, 6, 7, 8 in accordance with the invention, one proceedes as follows in order to produce a housing 2 with a disc 1 in accordance with the invention. In a first step, the housing 2 is moulded. Hereby, the outer mould parts 5, 6 are located in a contacting position, so that the dividing surfaces 50, 60 sealingly contact eachother. The cores 7, 8 are also brought together in the channel 51, 61, which is a mould within the two mould parts 5, 6, so that the front end-surfaces 70, 80 of the cores 7, 8 sealingly contact eachother along a substantial part of said front end-surfaces. The position of each core is such that the diametrically extending grooves 71, 81 are parallel and coaxial and further coaxially positioned in relation to the holes 53, 63 which are present in plane A. According-ly, there is sealing contact along the front end-surfaces of the cores, except at the transversal recesses 73, 83. Here, however, the seal is achieved by means of the pins 3, 4, i.e. by positioning the pins in an inner location so that each pin 3, 4 with its respective end 30 and 40 sealingly interacts with said recesses 73, 83. What now remains is a cavity being sealed off, which cavity corresponds to the configuration of the housing 2. The cavity is delimited inwardly in plane B by a circular channel 21, whose mould is determined by the cores 7, 8. The cavity presents a second through-passing hole, which extends in a first plane A and whose mould is determined by the mould of the pins 3, 4. Accordingly, the housing 2 is produced by supplying a plastic material into said cavity. The plastic material is preferably thermo-formed.

When the housing has stiffened sufficiently, i.e. in the preferred case, when the temperature has dropped sufficiently (has been sufficiently cooled), the second step can be initiated. In the second step, the actual disc is produced in situ within the housing 2. In this second step, the outer mould parts 5, 6 are kept in their respective positions. The cores 7, 8 and the pins 3, 4, however, are moved. The two cores 7, 8 are moved to a position where they do not contact eachother, so that a certain distance is created therebetween, which distance determines the thickness of the material of the disc 1. The two pins 3, 4 are also moved to a retired position where the distance between the end-surfaces 31, 41 determines the length of the shaft of the disc. These mentioned positions are clearly shown in Fig. 5. Since the housing 2 is kept in a form, a cavity is shaped which, at the actual disc unit 14, is delimited by the end-surfaces 70, 80 of the cores and which, at the shaft portion 10, is partly delimited by the through hole of the housing 2 and partly by the through hole 53, 63 in each mould part and which, as has already been mentioned, has a length that is determined by the position of the pins 3 and 4 respectively. Consequently, the disc 1 can now directly be formed by supplying a second, shapable mass. If thermoplastic mass is used, one of the conditions is that the temperature of this second mass does not exceed the melting temperature of the housing 2 (in its latter state). After appropriate cooling, the housing 2 with the butterfly disc is ready to be taken out of the mould. Thereby, the cores 7, 8 are taken out of the mould along the plane B and the outer mould parts 5, 6 and the pins 3, 4 are taken apart in plane A. An advantage with this method is that possible irregularities on the surface of the housing are directly shaped on the disc during the moulding, so that a perfect sealing contact is always achieved between the housing and the disc.

By using different plastic materials with different qualities, it is possible to vary certain variables in order to optimize a desired variable. It is prior knowledge that varying amounts of shrinkage

(or no shrinkage at all) of the various parts 1, 2 of the component, can be achieved by adding different substances or by using different pressures in the mould. Accordingly, it is possible to shape a housing and a disc so that the disc can only be moved against a large resistance but where the sealing is extremely good, by controlling it in such a manner that the housing 2 shrinks more than the disc 1. In a preferred embodiment, the disc is given a relative shrinkage of 0.3 % whereas the housing is controlled to have a shrinkage of circa 0.5 %. If, on the other hand, the sealing qualities are not of the highest priority, and, instead, the highest priority is that the disc should be easily rotatable, it is possible to use a relation of shrinkage so that the disc 1 shrinks more than the housing 2. This, however, can also be achieved by chilling the housing 2 so much that all shrinkage has finished (which normally is not the case) before the second step is initiated. After the shrinkage has finished, the diameter of the cavity which is to mould the disc, will be smaller. Therefore the disc in its turn will shrink to a diameter which in turn will be smaller than the delimiting surfaces of the housing. Accordingly, it is also possible in this manner to produce a device where the parts are easily moved in relation to each other.

Another factor which is possible to vary, as has already been mentioned before, is how hard the mass is pressurized within the form. High pressure leads to expansion of the finished product whereas low pressure leads to the opposite effect. Accordingly, it is also possible to work with the pressurization of the mould in order to achieve optimal interrelation between the two parts which are moulded in the two different steps.

Fig. 7 shows a modification according to the invention, i.e a ball well comprising a housing 2 and a ball 1. The ball comprises a through hole 15, which, depending on its position, enables flow through the channel 21 of the housing 2. The ball is rotatably arranged about an axis 10, which preferably is rotated by means of a manoeuvre device 16, which preferably is integrally made with the shaft 10.

For the production of such a modified device in accordance with the invention, the ball is firstly produced in a separate tool in a first step. Thereafter, the ball is positioned in a second tool, which has two outer mould parts and two cores, whereby the cores are preferably movable in a plane which is in line with the normal of the dividing plane of the outer mould parts, so that the shaft 10 of a ball 1 is positioned in the dividing plane. The outer mould parts have inner surfaces whose configurations determine the outer shape of the housing. The cores have a diameter which is at least of the same size (or can be larger) as the diameter of the hole 15 of the ball 1 and has to be sealingly positioned in relation to a respective opening of the ball 1, as do the mould parts, before the shapeable mass is introduced. In a preferred case, the housing is moulded when the ball is located in a closed position, i.e. in a sealing position. The reason is that this is the position wherein optimal interaction between the two sealing parts of the ball 1 and the housing 2 respectively is attained in order to achieve optimal sealing ability. A prerequisite in order to obtain this is that the channel 15 is sealed off during moulding. This sealing-off can be achieved by means of one core (not shown), or two, which seals the channel 15 from inside, i.e. either totally fills the channel 15 or just blocks one end each. After moulding, these latter cores can be removed.

Alternatively, a casting mould can be used which in principle corresponds to the one shown in Figures 4 and 5. A difference in relation to the above-described tool is that the cores 7, 8, have to be formed either with spherical end-surfaces corresponding to the radius of the ball 1 or, in accordance with the above, with the diameter that seals the opening of the ball. Further, the ball is preferably moulded with diametrically positioned circular recesses whose diameter corresponds to the diameter of said pins 3, 4. When moulding the housing 2, the cores 7, 8 are positioned in order to seal against the hole 15 of the ball 1 and the end-surfaces 30, 40 of the pins within said latter recesses. When the different mould parts (accordingly also the outer mould parts 5, 6) are sealingly positioned in their respective positions, it is possible to supply the plastic mass, which will form the housing. Thanks to the pins 3, 4, it is possible to use a different shaft material (e.g steel) for the ball, which sometimes could be preferred.

What has been described above can be varied within the scope of the following claims. Accordingly, which has already been indicated, the invention is not limited to housing and a disc intended for the use with gases, but can also be used for liquids. Further, as also has been indicated, hardening plastics can be used and, of course, in different combinations, e.g. a disc made of hardening plastics and a housing made of thermo plastics.

Differing from the method that is presented in relation to Figures 2 and 5, it is also possible to mould the disc in an obliquely positioned state, within the cores, i.e. without using the housing 2 for the sealing edge 11 of the disc. For such a method it is not necessary to reposition the cores 7, 8 from the first step to the second, but it is only necessary to reposition the pins 3, 4 in order to enable the plastic mass to reach the cavity between the two cores. The disadvantage, however, is that the disc

is then not exactly moulded in relation to the housing. Moreover, it is to be realized that the invention is not solely limited to only two interacting parts, but can also be directed to any of the parts per se, especially a disc in accordance with above.

It is evident for the skilled man that the mass used for the moulding can be chosen from a plurality of different possible masses, such as ABS-plastics, polyethylene, etc (which among other things also is known from a number of documents within the area, e.g. US-A-4 702 156). Further, it is evident that the runner (not shown) can be positioned in many different ways, but that this is not an essential feature of the invention.

Claims

1. A device for controlling the volume of flow, comprising a flow controlling device (1) which is rotatably arranged about an axis (10) in a channel (21), whereby said channel is preferably arranged within a housing (2), **characterized** in that the sealingly interacting surfaces of the channel (21) and the flow controlling device (1) in a certain predetermined position have a configuration which totally corresponds to eachother, since one of the surfaces is a moulding of the other.

2. A device for controlling of the volume of flow according to claim 1, **characterized** in that said flow controlling device (1) is a butterfly disc and that the channel (21) is arranged in a butterfly valve housing (2), whereby at least one of the parts (1 resp. 2) is an integral unit.

3. A device for controlling of the volume of flow according to claim 2, **characterized** in that said disc (1) comprises an integral shaft (10) for rotatable positioning of an integral disc (14), an integral, sealing edge (11) lying in one and the same plane and at least one integral flow reducing means (12, 13) which protrudes from said plane, whereby preferably said flow reducing means (12, 13) consists of one portion protruding from the centre of the shaft and which extends in a radial direction, and a tangentially extending portion which protrudes from said first portion's outer end, and that the material thickness for the two portions is essentially the same.

4. A device for controlling of the volume of flow according to claim 3, **characterized** in that said sealing edge (11) is arranged on the free edge of the tangentially extending portion.

5. Method for the production of a movable part (1) and a housing (2) which accomodates the movable part, whereby preferably the parts (1, 2) are moulded in one and the same tool, preferably a device according to claim 4, and preferably the housing (2) is moulded in a first step and the disc (1) is moulded in a second step, **characterized** in that said movable part (1) and housing (2) are produced in at least two steps in such a manner that the movable part (1) comprises a substantially sealing portion (11) which is intended to interact with a predetermined portion of said housing (2), whereby preferably said movable part is a butterfly disc (1) and said housing is a butterfly valve housing (2).

6. Method according to claim 5, **characterized** in that at least one step of the moulding is a thermo-forming and that the temperature of the mass that is introduced in the second step is below the melting temperature of the mass in the first step.

7. Means for carrying out the method of claim 5, **characterized** in that it comprises at least two outer mould parts (5, 6) which are movable mainly in a first plane A, two cores (7, 8) which are movable in a second plane B, which plane is substantially parallel with the normal of said first plane A, and two pins (3, 4) which are coaxially movable in said first plane A within or adjacent each one of said outer mould parts (5, 6).

8. Method according to claim 6, with the means according to claim 7, **characterized** in that the housing (2) is moulded in a first step whereby, the outer mould parts (5, 6) are located in a contacting position, so that the dividing surfaces (50, 60) sealingly contact each other, the cores (7, 8) contact eachother with a channel (51, 61) which is formed by the two mould parts (5, 6), so that the front surfaces (70, 80) along a substantial part are in sealing contact with eachother, and, the pins (3, 4) are located in a first inner position, so that each one of the pins (3, 4) with its respective ends (31, 41) sealingly interacts with predetermined portions (71, 81 resp. 72, 82) of the two cores (7, 8), whereafter the thermo-formable moulding of the housing (2) can be carried out by introducing a thermo-formable mass into the cavity which is defined by the mould parts (3, 4, 5, 6, 7, 8), and that the disc is moulded in a second, subsequent, step, whereby; the outer mould parts (5, 6) are maintained in a position, the two cores (7, 8) are located in a position with-

out contact with each other so that a certain distance is created between them, which distance determines the thickness of the material, and both pins are located in a second, withdrawn position where the distance between the ends (31, 41) exceeds the diameter of said channel (51, 61), which distance determines the length of the shaft of said disc (1), whereafter a thermo-formable mass can be introduced in order to form said disc (1).

9. Method according to claim 5, **characterized** in that one of the sealing portions, either of the housing (2) or the movable part (1), is shaped by the other therewith interacting portion, whereby the shaping process takes place in a sealing position of the device.

10. Method according to claim 5, **characterized** in that said movable part (1) is moulded in a first step and that said housing (2) is moulded around said movable part (1) in a second step, whereby preferably a ball valve with a housing (2) is formed within which a ball (1) having a hole (15) is rotatably arranged about at least one shaft pin (10).

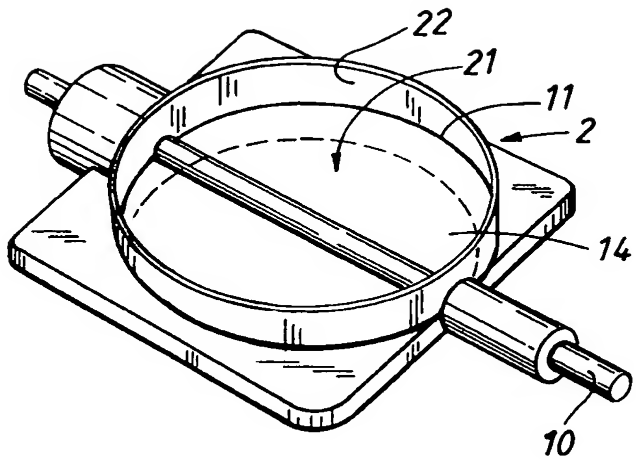

FIG.1

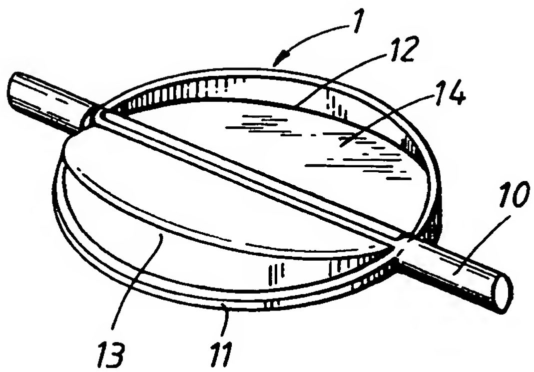

FIG.3B

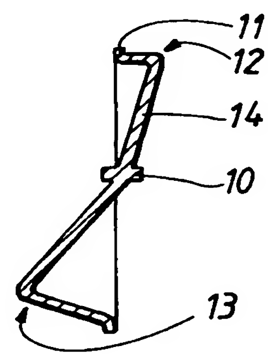

FIG.3A

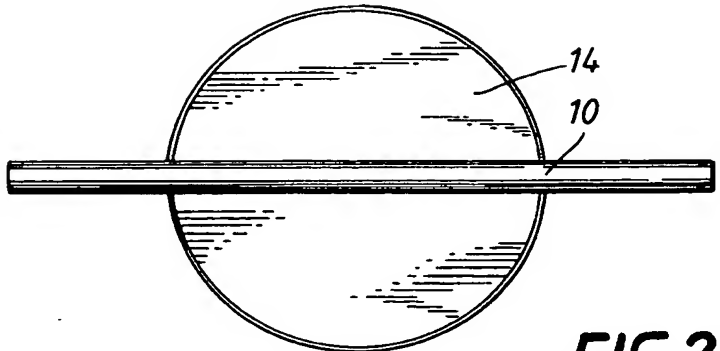

FIG.2A

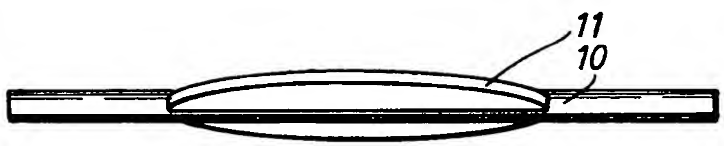

FIG.2B

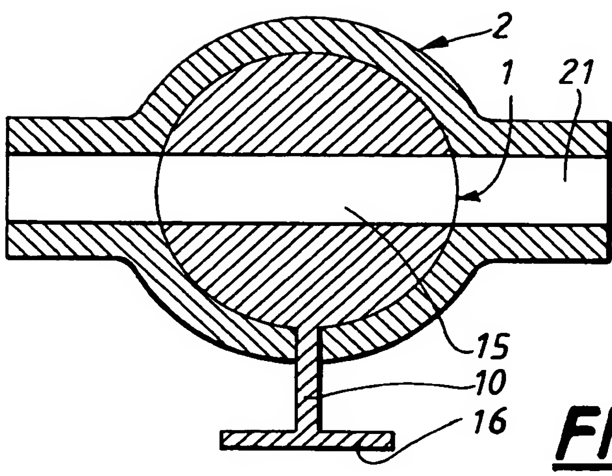

FIG.7

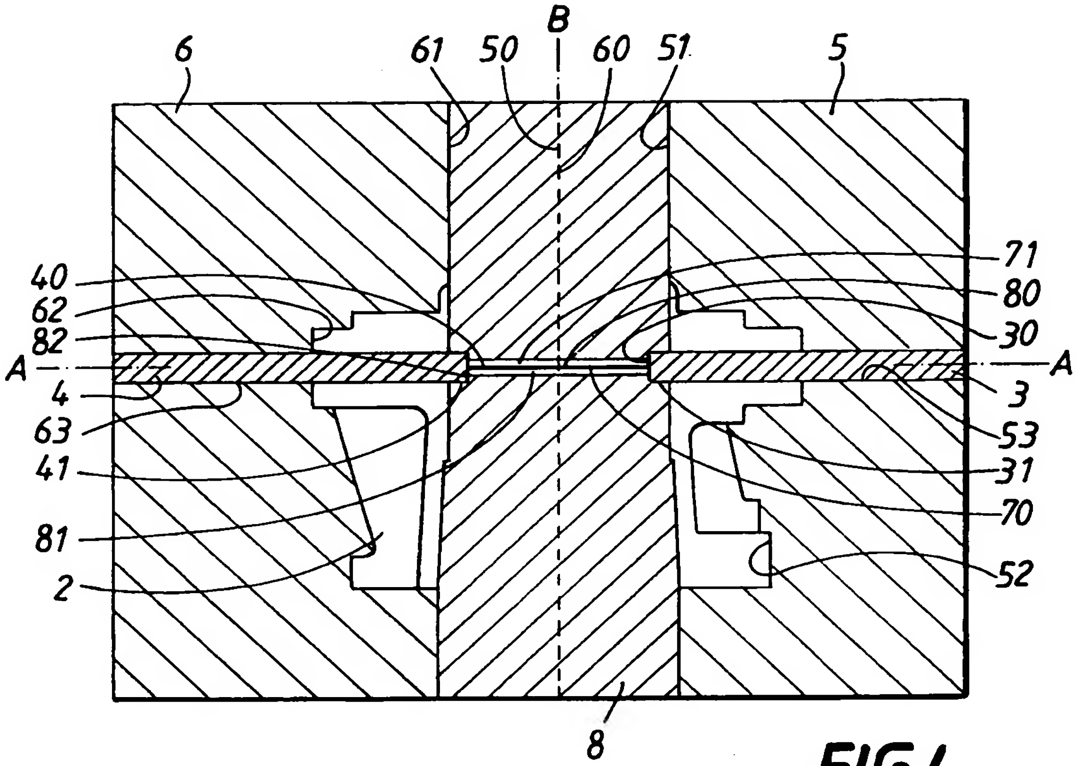
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FIG.4

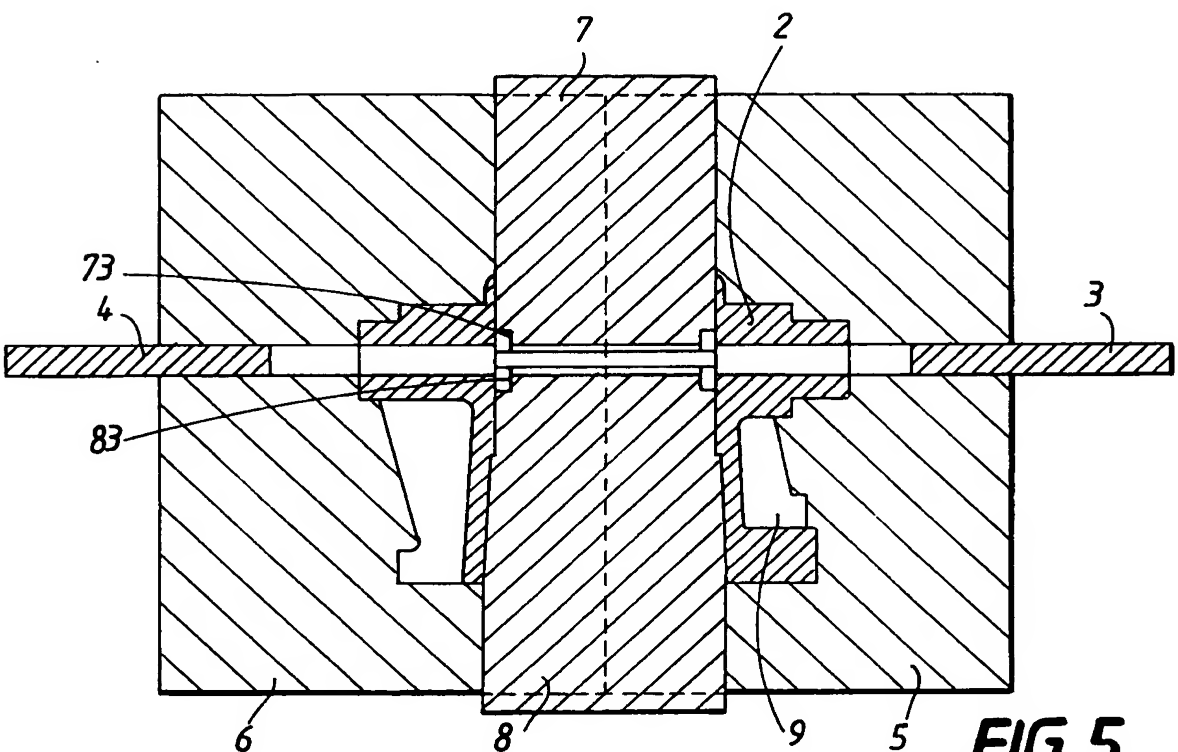
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FIG.5

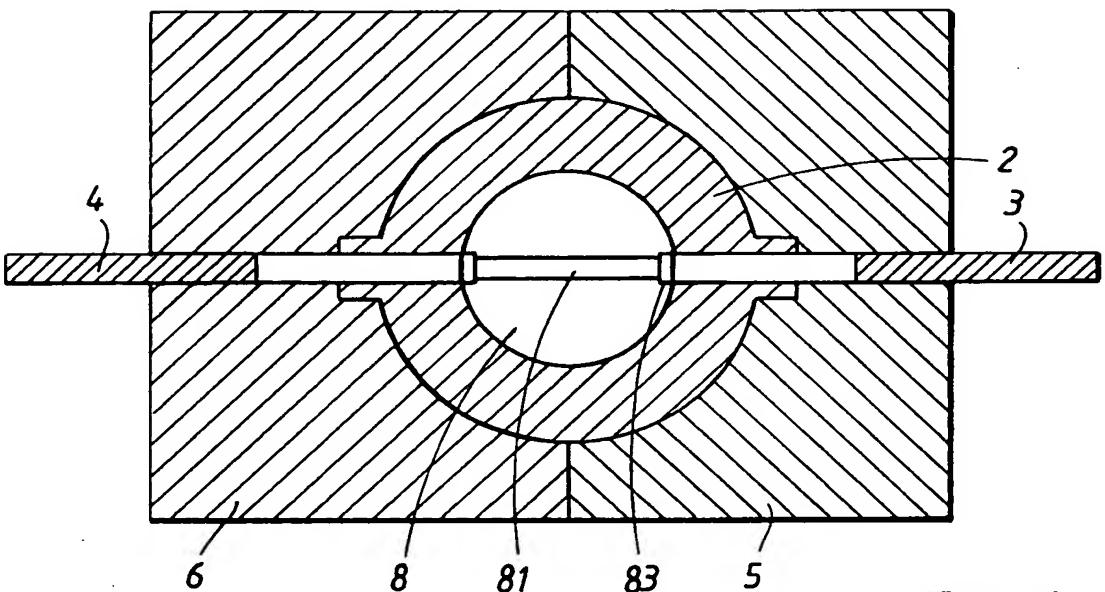

FIG.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 85 0355

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-1 327 745 (STÜBBE) * Page 2, right-hand column, lines 25-57 *	1,5,6,10	B 29 C 45/00 F 16 K 27/02
X	FR-A-2 028 256 (SUSQUEHANNA CORP.) * Page 4, lines 4-30 *	1,5,6,10	
X	GB-A-2 117 694 (NIHON) * Page 3, line 106 - page 4, line 83 *	5,6,7,8	
X	FR-A-2 316 060 (MATSUSHITA) * page 2, line 40 - page 4, line 20 *	5,6,7,8	
A	US-A-4 740 347 (SLOAN)		
A	US-A-3 771 764 (MIYAUCHI)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 29 C
F 16 K

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	03 June 91	VERELST P.E.J.

CATEGORY OF CITED DOCUMENTS

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